

New earthworms of *Pheretima* and *Pithemera* (Oligochaeta: Megascolecidae) from Mt. Arayat, Luzon Island, Philippines

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New earthworms of *Pheretima* and *Pithemera* (Oligochaeta: Megascolecidae) from Mt. Arayat, Luzon Island, Philippines. - Three new species of *Pheretima* and two new species of *Pithemera* are described from Mt. Arayat: *Pheretima arayataensis* sp. n., *Pheretima simsi* sp. n., and *Pheretima castilloi* sp. n., *Pithemera rotunda* sp. n., and *Pithemera philippinensis* sp. n. *Pheretima arayataensis* sp. n., *Pheretima simsi* sp. n., and *Pheretima castilloi* sp. n. have spermathecae in segment ix, vi, and vi-viii, respectively. *Pithemera rotunda* sp. n., and *Pithemera philippinensis* sp. n. have spermathecae in segment v-ix. The former species has numerous circular genital markings, but the latter *Pithemera* species has no genital markings. Descriptions of the new species are provided, including illustrations of the ventral view, male pore region, and spermathecae.

Key-words: Earthworms - *Pheretima* - *Pithemera* - Megascolecidae - Oligochaeta - Mt. Arayat - Philippines - taxonomy.

INTRODUCTION

Mt. Arayat is an isolated volcanic mountain in the large plains of central Luzon, north of Manila. Its forested upper elevations have always been isolated from other mountain ecosystems, such as the central Cordillera to the north and west, the Caraballo Range to the north, and the southern Sierra Madre to the east. The remaining forests of Mt. Arayat are an important refuge for biota whose habitats would otherwise be destroyed in the region. Its biogeographic importance as an isolated peak is now accentuated by deforestation and conversion of land to intensive agriculture. As part of a biotic survey of the earthworms of the Philippines, specimens were collected from Mt. Arayat in March, 2001. In this paper, we report three new species of *Pheretima* Kinberg, 1867 and two new species of *Pithemera* Sims & Easton, 1972. James (2004) described 21 new species of Megascolecidae of which 18 were new species of the genus *Pheretima* from the Mt. Kitanglad Range, Mindanao Island. He followed the systematics of Sims & Easton (1972). These authors assigned species

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with the intestinal caeca(um) originating in or near xxii to this genus, *Pithemera*. They also defined four species groups within *Pithemera*, one of which is the *bicincta* group, containing the generotype *Pithemera bicincta* (Perrier, 1875). We report 2 new species of the *bicincta* group herein.

Holotypes and paratypes are deposited in the National Museum of Annelids of the Philippines (NMA). Paratypes are deposited in the Field Museum of Natural History (FMNH), and the Museum of Natural History of Geneva (MHNG).

DESCRIPTIONS

Pheretima arayatensis James & Hong sp. n.

Figs 1A-B

Material: Holotype: One clitellate (NMA 0003741): Philippines, Luzon Island, Pampanga Province, Mt. Arayat (15°12.29'N, 120°43.25'E), 410 m, litter layers in forest, 14 March 2001, Y. Hong & A. Castillo colls. 3 paratypes: 1 clitellate (NMA 0003746), 1 clitellate (FMNH 10012), 1 clitellate (MHNG 34807): Same data as for holotype. Other material: Same data as for holotype, 4 clitellate, 18 a clitellate specimens; Mt. Arayat (15°12.34'N, 120°43.90'E), 330 m, litter layers in forest, 1 clitellate, 1 semiclitellate, 13 March 2001.

Etymology: The species is named for its type locality.

Diagnosis: Spermathecal pore in 8/9, brown dorsal pigment, genital marking absent.

Description: Brown dorsal pigment. Dimensions 88-141 mm by 5.8-6.3 mm at segment x, 7.0-7.2 mm at xxx, 5.1-5.5 mm at clitellum, segments 96-115; body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 54 at vii, 87 at xx; 5-6 between male pores, size, distance regular; setal formula AA:AB:YZ:ZZ = 2:1:2:4 at xiii. Clitellum annular xiv-xvi; setae invisible externally.

First dorsal pore 12/13, spermathecal pore midventral deep in intersegmental furrow 8/9, with thickened surrounding tissue, monothecate. Female pore single in xiv, 0.3 mm oval shape, 0.5 mm openings of copulatory bursae paired in xviii, distance between male pores 2.1 mm. Genital marking lacking.

Septa 5/6-7/8 thick, 8/9 absent, 9/10 thin, only a small membrane connected to 10/11, not to body wall, 10/11-13/14 thick, muscular. Gizzard large in viii-x, intestine begins in xv, small paired lymph glands from xxviii along dorsal vessel; intestinal caeca simple, originating in xxvii, and extending anteriorly to xxii, each consisting of a finger-shaped sac; typhlosome low simple fold from xxvii. Hearts x-xiii esophageal; ix lateral, right side large, left very reduced.

Ovaries and funnels in xiii, single spermatheca in ix with nephridia on spermathecal ducts; spermatheca with small ampulla, ducts shorter than ampulla, 2 diverticula each composed of 5 separate chambers on single stalks or double stalks terminating in two chambers, club-shaped. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles two pairs in xi, xii with dorsal lobes, pseudovesicles xiii, prostates in xviii, with stout muscular duct entering center of the copulatory bursae without stalked glands. Vas deferens muscular xiv-xviii. Pads or other structures like penis on inside of copulatory bursae.

Remarks: The species shares the brown dorsal pigment, dimensions, setae, and monothecate condition with *Pheretima ambonensis* Cognetti, 1913 from Ambon, Indonesia. *Pheretima arayatensis* has 2 spermathecal diverticula each composed of 5

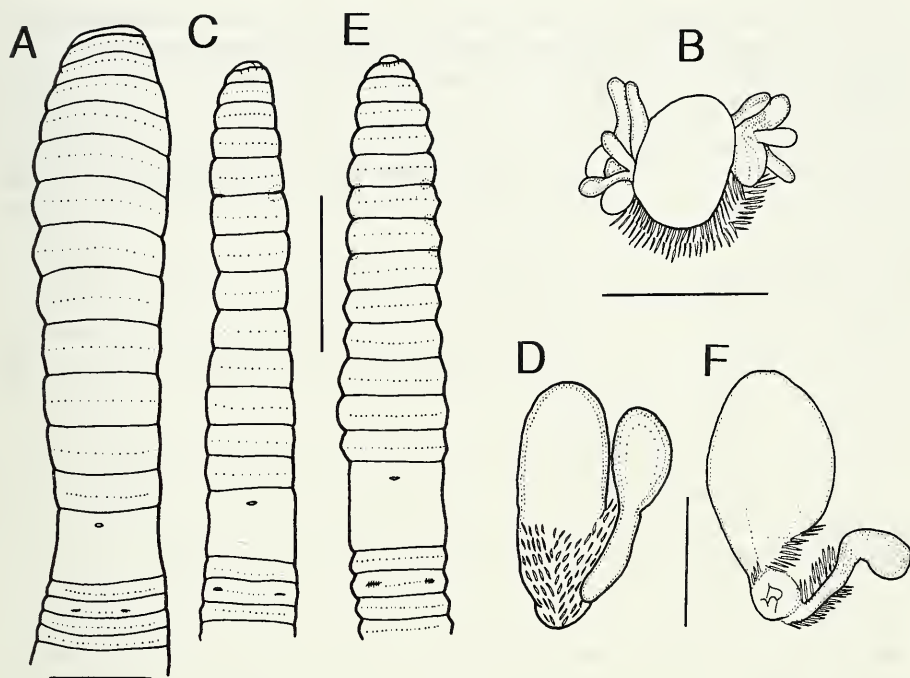


FIG. 1

A-B. *Pheretima arayatensis* sp. n. A: ventral view; B: spermathecae. C-D. *Pheretima simsi* sp. n. C: ventral view; D: spermathecae. E-F. *Pheretima castilloi* sp. n. E: ventral view; F: spermathecae. Scale bars = 5 mm (A, C, E), 2 mm (B), 1 mm (D, F).

separate chambers on single stalks or double stalks terminating in two chambers, but *P. ambonensis* has a thick duct and only 2 diverticula on single stalks. Also *Pheretima arayatensis* has its spermathecal pore in 8/9 and spermatheca in ix, but *P. ambonensis* has the spermathecal pore in 7/8 and spermatheca in vii.

Pheretima simsi James & Hong sp. n.

Figs 1C-D

Material: Holotype: One clitellate (NMA 0003742): Philippines, Luzon Island, Pampanga Province, Mt. Arayat (15°12.41'N, 120°44.45'E), 1050 m, litter layers in forest, 13 March 2001, Y. Hong & O. Castillo colls. 3 paratypes: 1 clitellate (NMA 0003747), 1 clitellate (FMNH 10013), 1 clitellate (MHNG 34808): Same data as for holotype. Other material: Same data as for holotype, 4 clitellate, 6 a clitellate specimens; Mt. Arayat (15°12.34'N, 120°43.90'E), 330 m, litter layers in forest, 9 clitellate, 2 a clitellate, 13 March 2001.

Etymology: Named for Dr R. W. Sims, who made good contributions to earthworm systematics.

Diagnosis: Spermathecal pores in 5/6. Diverticulum, as long as ampulla, chamber and stalk showing spermatozoal iridescence, nephridia covering duct-ampulla junction, part of ampulla.

Description: Brown dorsal pigment. Dimensions 68-91 mm by 2.6-2.8 mm at segment x, 2.8-3.1 mm at xxx, 2.7-3.0 mm at clitellum, segments 82-97; body cylin-

drical in cross-section. Setae regularly distributed around segmental equators, numbering 31-33 at vii, 39-47 at xx; 6-8 between male pores, size, distance regular; setal formula AA:AB:YZ:ZZ = 1.5:1:2:3 at xiii. Clitellum annular xiv-xvi; setae invisible externally.

First dorsal pore 11/12, 12/13, spermathecal pores in 5/6, at lateral margin of ventrum, white color, with slightly protuberant lips. Female pore single in xiv, 0.4 mm oval shape, 0.5 mm openings of copulatory bursae paired in xviii, distance between male pores 2.5 mm. Genital marking lacking.

Septa 5/6-8/9 thin, 9/10 absent, 10/11-12/13 thick, muscular, 13/14 thin. Gizzard usual in viii, intestine begins in xv, small paired lymph glands from xxviii along dorsal vessel; intestinal caeca simple, originating in xxvii, and extending anteriorly about to xxvi, each consisting of a finger-shaped sac; typhlosole low simple fold from xxvii. Hearts x-xiii esophageal; ix lateral, viii to gizzard, vii lateral, with branches to anterior gizzard wall.

Ovaries and funnels in xiii, paired spermathecal in vi with nephridia on spermathecal ducts; spermatheca with small ampulla, duct very short, diverticulum, as long as ampulla, chamber and stalk showing spermatozoal iridescence, nephridia covering duct-ampulla junction, part of ampulla. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles two pairs in xi, xii with narrow dorsal lobes, prostates in xvii- xix, with stout muscular duct entering center of the copulatory bursae without stalked glands. Copulatory bursa opening flanked by anterior, posterior pads, male pore within large convoluted opening on roughly conical protrusion from copulatory bursa roof.

Remarks: *Pheretima simsi* keys to the *urceolata* group in Sims & Easton (1972), which is composed of two species, *P. urceolata* Horst 1893 and *P. baweanensis* Michaelsen, 1924. Gates (1961) synonymized these two species and *P. ditheca* Michaelsen, 1928. The species shares the lack of setae in the clitellum, 31 setae per segment at vii, and spermathecal pores in 5/6 with *P. urceolata*. *Pheretima simsi* differs from *P. urceolata* in having as the ampulla long as the diverticulum, and in having short caeca. The locality of *Pheretima simsi* is close to human disturbance and activity, as was the collection site of *P. urceolata*. The present species is similar to *Pheretima kitangladensis* (James, 2004), but *P. kitangladensis* has no dorsal or ventral setal gaps, and has vertical lamellae in the esophagus. Also, *P. kitangladensis* is quite remote from human disturbance at a high elevation site (2250 m), but *Pheretima simsi* and *P. urceolata* were collected from low and mid- elevation sites (330-1050 m, 1100 m). *P. urceolata* was collected from Sumatra, Kupang, Timor, Indonesia and *P. kitangladensis* from Mt. Kitanglad Range, Mindanao Island, Philippines.

Pheretima castilloi James & Hong sp. n.

Figs 1E-F

Material: Holotype: One clitellate (NMA 0003743): Philippines, Luzon Island, Pampanga Province, Mt. Arayat (15°12.43'N, 120°44.38'E), 900 m, litter layers in forest, 13 March 2001, Y. Hong & A. Castillo colls. 3 paratypes: 1 clitellate (NMA 0003748), 1 clitellate (FMNH 10014), 1 clitellate (MHNG 34809): Same data as for holotype. Other material: Mt. Arayat (15°12.41'N, 120°44.45'E), 1050 m, litter layers in forest, 4 clitellate, 1 a clitellate, 13 March 2001.

Etymology: The species is named after the type's collector, Augusto Castillo.

Diagnosis: Spermathecal pores in 5/6-7/8, genital marking absent.

Description: Brownish dorsal pigment. Dimensions 59-81 mm by 3.1-3.3 mm at segment x, 3.2-3.3 mm at xxx, 3.0-3.3 mm at clitellum, segments 64-81 body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 26-28 at vii, 46-50 at xx; 7-12 between male pores, size, distance regular; setal formula AA:AB:YZ:ZZ = 1:1.5:2:6 at xiii. Clitellum annular xiv-xvi; setae invisible externally.

First dorsal pore 12/13, paired spermathecal pores in 5/6-7/8, at lateral margin of ventrum, distance between spermathecal pores 3.0 mm. Female pore single in xiv, 0.4 mm oval shape, 0.4 mm openings of copulatory bursae paired in xviii, distance between male pores 2.5 mm. Genital marking lacking.

Septa 5/6-7/8 thin, 8/9 absent, 9/10 very thin, attached to 10/11, 10/11 thick, 11/12-13/14 thin. Gizzard usual in viii-x, intestine begins in xv, small paired lymph glands from xxviii along dorsal vessel; intestinal caeca simple, originating in xxvii, and extending anteriorly about to xxiv, each consisting of a small finger-shaped sac; typhlosole very low simple fold from xxvii. Hearts x-xiii esophageal; ix lateral, very small viii to gizzard, vii lateral, extra esophageal vessel pharynx to ventral esophageal, then to clitellum area xiii to xiv, xv.

Ovaries and funnels in xiii, paired spermatheca in vi-viii, viii with nephridia on spermathecal ducts; spermatheca with small ampulla pouch, duct shorter than ampulla, diverticulum golf club-shaped, shorter than ampulla. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles two pairs in xi, xii with dorsal lobes, prostates in xvi- xviii, with stout muscular duct entering center of copulatory bursae without stalked glands. Copulatory bursa opening flanked by circular pads anterior, posterior, pads backed by glandular chambers, male pore within long slit on side of conical protrusion from copulatory bursa roof.

Remarks: In Sims & Easton (1972) *Pheretima castilloi* keys to a couplet offering a choice between one and four thecal segments, corresponding to the *urceolata* and *lejokana* (genital marking present), *damleiensis* (genital marking absent) species groups, respectively. However, the present species has three pairs of spermathecal pores in 5/6-7/8. Therefore *Pheretima castilloi* is unlike all known *Pheretima*.

Pithemera rotunda James & Hong sp. n.

Figs 2A-B

Material: Holotype: One clitellate (NMA 0003744): Philippines, Luzon Island, Pampanga Province, Mt. Arayat (15°12.41'N, 120°44.45'E), 1050 m, litter layers in forest, 13 March 2001, Y. Hong & A. Castillo colls. 3 paratypes: 1 clitellate (NMA 0003749), 1 clitellate (FMNH 10015), 1 clitellate (MHNG 34810): Same data as for holotype. Other material: Same data as for holotype, 3 clitellate, 15 a clitellate specimens; Mt. Arayat (15°12.43'N, 120°44.38'E), 900 m, litter layers in forest, 7 clitellate, 1 a clitellate, 13 March 2001.

Etymology: The name *rotunda* is Latin for circular, referring to the shape of the genital marking.

Diagnosis: Spermathecal pores in 4/5-8/9, male pores in xviii, on 0.3 mm small hardened slightly protuberant circular porophore. Genital markings numerous circular within thickened epidermal area.

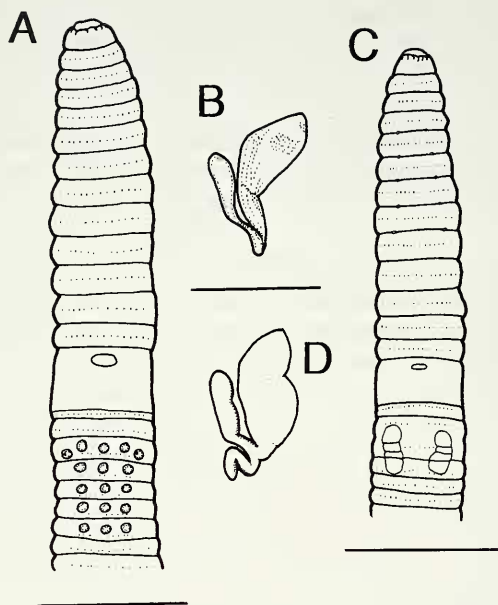


FIG. 2

A-B. *Pithemera rotunda* sp. n. A: ventral view; B: spermathecae. C-D. *Pithemera philippinensis* sp. n. C: ventral view; D: spermathecae. Scale bars = 5 mm (C), 2 mm (A), 1 mm (B, D).

Description: Worm unpigmented. Dimensions 31-44 mm (acilitellates 25-32) by 2.0-2.4 mm at segment x, 2.3-2.6 mm at xxx, 1.9-2.0 mm at clitellum, segments 79-91; body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 49-54 at vii, 48-61 at xx; 9 between male pores, size, distance regular; setal formula AA:AB:YZ:ZZ = 2:1:1:3 at xiii. Clitellum annular xiv-1/2xvi; xvi setae visible, dorsal pore invisible externally.

First dorsal pore 12/13, five pairs of spermathecal pores in 4/5-8/9, very small white spot in lateral margin of ventrum. Female pores paired in xiv, 0.3 mm oval shape, male pores in xviii, on 0.3 mm small hardened slightly protuberant circular porophore, pores 1.9 mm apart. Circular raised genital markings numerous; 2 on right side xviii, 3 between male pores xviii, 3 presetal in xix, xx, xxi, xxii; genital markings within white thickened epidermal area.

Septa 5/6 thin, 6/7 thick, 7/8 thin, 8/9 absent, 9/10, 10/11 thin, 11/12, 12/13 some muscular thickening, 13/14 thin. Gizzard usual in viii-ix, intestine begins in xv; intestinal caeca simple, originating in xxii, and extending anteriorly about to xxi, each consisting of a small triangle-shaped sac; typhlosome about 1/3 lumen diameter simple fold from xxii. Hearts x-xii esophageal; ix lateral, viii absent, vi, vii lateral.

Ovaries and funnels in xiii, spermathecae in v-ix; no nephridia on spermathecal ducts; spermathecae with small strawberry-shaped ampulla, ducts shorter than ampulla, diverticulum club-shaped, shorter than ampulla. Male sexual system holan-

dric, testes and funnels in single large sacs in x, xi; sacs attached to front side of septum 10/11, 11/12, sacs do not enclose hearts, sacs of xi enclose seminal vesicles. Seminal vesicles two pairs in xi, xii without dorsal lobes, prostates multilobed in xvi- xx, ectal half of duct expanded, muscular.

Remarks: *Pithemera rotunda* keys to the *bicincta* group in Sims & Easton (1972), which is composed of two species, *Pithemera bicincta* (Perrier, 1875) and *Pithemera violacea* (Beddard, 1895). Like *P. bicincta* and *P. violacea*, *P. rotunda* has spermathecal pores in 4/5-8/9, and the spermathecal ampulla is longer than the diverticulum. *Pithemera rotunda* has three circular papillae in segments xviii to xxii, but *P. bicincta* has paired genital papillae extending from segments xviii to xix, and 1 pair of genital papillae just behind the male pores on 18/19. Only one pair of genital papillae is present in *P. violacea* just lateral to and behind the male pores (Beddard, 1895).

***Pithemera philippinensis* James & Hong sp. n.**

Figs 2C-D

Material: Holotype: One clitellate (NMA 0003745): Philippines, Luzon Island, Pampanga Province, Mt. Arayat (15°12.41'N, 120°44.45'E), 1050 m, litter layers in forest, 13 March 2001, Y. Hong & A. Castillo colls. 2 paratypes: 1 clitellate (FMNH 10016), 1 clitellate (MHNG 34811): Same data as for holotype. Other material: Same data as for holotype, 11 acitellate specimens; Mt. Arayat (15°12.43'N, 120°44.38'E), 900 m, litter layers in forest, 3 clitellate, 1 acitellate, 13 March 2001.

Etymology: The species is named for its type locality.

Diagnosis: Spermathecal pores in 4/5-8/9, male pores xviii on foot print- shaped pads extending to 17/18-18/19. Genital marking absent.

Description: Light brown dorsal pigment. Dimensions 51-54 mm (semiclitellate 41-48) by 2.3-2.5 mm at segment x, 2.8-3.3 mm at xxx, 2.5-2.6 mm at clitellum, segments 78-90; body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 56-68 at vii, 49-61 at xx; 9 between male pores, size, distance regular; setal formula AA:AB:YZ:ZZ = 3:1:1:2 at xiii. Clitellum annular xiv-1/2xvi; xvi setae visible, dorsal pore invisible externally.

First dorsal pore 12/13, five pairs of spermathecal pores in 4/5-8/9, small white spots, lateral. Female pores paired in xiv, 0.4 mm oval shape, male pores xviii on foot print-shaped pads extending to 17/18-18/19, 2.0 mm between male pores. Genital marking lacking.

Septa 5/6-7/8 thin, 8/9 absent, 9/10-11/12 thick, 12/13, 13/14 thin. Gizzard usual in viii-ix, intestine begins in xv; intestinal caeca simple, originating in xxii, and extending anteriorly about to xxi, each consisting of a small triangle-shaped sac; typhlosole simple fold about 1/4 lumen diameter from xxii. Hearts x-xii esophageal; ix lateral, viii lateral.

Ovaries and funnels in xiii, spermathecae in v-ix; no nephridia on spermathecal ducts; spermathecae with small pouch, diverticulum sausage-shaped, as long as ampulla. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles two pairs in xi, xii, prostates in xvii- xix, two main lobes, ental half of ducts slender, non muscular; ectal half of ducts enlarged, muscular tapered at both ends; body wall surface over external male pads covered with densely packed, tiny tubules, probably nephridia or modified nephridia serving a glandular function.

Remarks: The species also keys to the *bicincta* group in Sims & Easton (1972), but unlike the other members, *Pithemera philippinensis* has foot print-shaped pads extending over 17/18-18/19.

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